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|------------------------|--|
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SPECIFICATIONS

1. Title of the Invention

Fishing Pole

2. Claims

Fishing pole so characterized that it is a fishing pole such as molded by wrapping and hot-curing a prepreg comprised by immersing fiber material in resin, and many minute hollow spheres are interposed in the above-mentioned prepreg.

3. Detailed Specifications

This invention pertains to a fishing pole formed by wrapping a prepreg comprised by immersing fiber material in resin.

Generally, this type of fishing pole uses fabric in which inorganic fiber such as fiberglass or various types of organic fibers are woven at a constant ratio in the warp and woof directions, or a prepreg formed by immersing a sheet such as roping in a thermosetting resin such as epoxy

resin or phenolic resin. Said prepreg is formed by wrapping several times in a cylinder.

Fishing poles formed of glass prepregs are inadequate in their physical properties, especially strength to weight ratio against longitudinal bending. Therefore, to raise this physical property, the content of the above-mentioned fiber relative to resin in the above-mentioned prepreg may be increased, but this increase is limited in terms of weight and also has problems in terms of cost.

In addition, when the above-mentioned fiberglass is replaced by or used with fiber such as carbon fiber or Kevlar fiber, because this carbon or other fiber has greater strength and elasticity than fiberglass, longitudinal bending strength is increased compared to using fiberglass and strength to weight ratio can be increased. However, this still cannot solve the problem described above.

Therefore, as a method that basically solves this problem, resin content relative to fiber content comprising the prepreg may be decreased as described above. This is perhaps because the weight ratio of resin in the overall prepreg is high.

However, because resin also acts as a binder between fibers, when resin content in the prepreg is decreased, this action is blocked. As a result, this causes problems such as cracking during bending.

Therefore, this invention is so characterized that many minute hollow spheres are interposed in the above-mentioned prepreg without changing the amount of resin that bonds fiber as described above—that is, using the amount required to achieve the function described above—and such that the weight of this required amount is lightened without reducing binder function.

That is, this invention notes that minute hollow spheres have extremely low specific gravity compared to the above-mentioned resin and fiber, and so forms a fishing pole that has superior strength to weight ratio and toughness to weight ratio.

The minute hollow spheres used in this invention have an outer diameter on the order of several micrometers, a unicellular globular shell structure comprised of thin film, and use hollow spheres comprised of an inorganic substance, organic substance, or metal. Moreover, inorganic materials are substances such as alumina, silica, shirasu, carbon, or glass; organic materials include natural substances such as soybean protein, cellulose derivatives, or natural rubber latex and synthetic substances such as polyvinyl alcohol, polystyrene, polyethylene, polyamide, epoxy, or polyurethane; and metallic materials are metals such as tungsten.

In addition, in terms of physical properties, these various types of hollow spheres have small grain density and are lightweight. By using these in a prepreg, a fishing pole can be offered that has superior ratios of strength to specific gravity and toughness to specific gravity.

The method for interposing these hollow spheres in a prepreg is any of dispersing and blending ahead of time in the above-mentioned resin and immersing the above-mentioned fiber in this resin, dispersing between fibers ahead of time and blending the above-mentioned resin with this fiber or immersing this in above-mentioned resin that has been blended with hollow spheres ahead of time, or passing through a fluid layer of hollow spheres immediately after immersing fiber in resin and injecting when the prepreg is hot-cured.

The granularity of these hollow spheres is determined together with factors such as the

resin material used, and is not subject to special limitations. In addition, the amount blended is not restricted so long as hollow spheres are stable when interposed in resin and do not cross-link to each other due to the resin and block the binder function of the above-mentioned resin.

Below, an embodiment of the fishing pole of this invention is explained based on the figures.

(1) is a prepreg cut to a particular size and shape. This prepreg (1) is formed by immersing cloth (2) in which warp (21) and woof (22) comprised of fiberglass are woven at a constant ratio in thermosetting resin (3) such as epoxy resin or phenolic resin.

Besides the above-mentioned fiberglass, the fiber material that comprises this prepreg (1) also may be an inorganic substance such as carbon fiber or an organic substance such as Kevlar fiber. It also may be a combination of these inorganic or organic substances. In addition, when the above-mentioned prepreg (1) is comprised of cloth (2), the ratio between its warp (21) and woof (22) is the standard ratio where warp (21) is greater than 1:1 or a ratio in which woof (22) is reduced from this standard ratio.

In addition, warp (21) and woof (22) of the above-mentioned cloth (2) uses thread comprised by bundling several very fine monofilaments. In the figures, however, the very fine monofilaments are omitted and these are shown as single threads. Moreover, needless to say, this warp (21) and woof (22) also may be formed of single threads.

(4) are minute hollow spheres interposed between the fiber material of prepreg (1) comprised as described above and specifically between the very fine monofilaments that comprise warp (21) and woof (22), or inside the above-mentioned thermosetting resin (3), or between inside said resin (3) and its surface and between said resin (3) and the above-mentioned warp (21) and woof (22), or in the above-mentioned fiber material and thermosetting resin (3).

For these minute hollow spheres (4), silica balloons with 50 to 100  $\mu\text{m}$  granularity are used at a ratio to resin of 20 to 30% by volume.

However, to interpose these minute hollow spheres (4) in the above-mentioned fiber material and resin or the like, when cloth (2) comprised as described above is immersed in thermosetting resin (3), the above-mentioned prepreg (1) is formed by dispersing and blending minute hollow spheres (4) in a layer of thermosetting resin (3), then passing the above-mentioned cloth (2) through this resin layer. In this way, the above-mentioned hollow spheres (4) become interposed inside resin (3).

In addition, in Figure 1, (5) is a coating layer installed on the outside of the above-mentioned prepreg (1), and is comprised of a glass cloth prepreg or fiberglass double prepreg. This coating layer (5) does not especially need to be installed, but is required if the surface is ground during finishing.

Moreover, to form a fishing pole by prepreg (1) comprised as described above, after wrapping the above-mentioned prepreg (1) several times around a core metal, a glass cloth prepreg that becomes the above-mentioned coating layer (5) is wrapped onto the outside of the above-mentioned prepreg (1) or not, cellophane tape is affixed tightly onto the outside, and this is cured by heating and baking in a heating furnace under pressure.

As described above, because this invention has many minute hollow spheres interposed in a prepreg, when inorganic fiber is used as the above-mentioned fiber material as a matter of

course, and even when such inorganic fibers or organic fibers are combined, weight can be greatly lightened.

Moreover, because hollow spheres have lower specific gravity than the above-mentioned fiber and resin, the superior physical properties of specific strength and specific toughness are obtained. Moreover, this does not particularly increase costs.

In addition, because hollow spheres have a spherical structure on the order of several micrometers, even when interposed in resin, these spheres are not cross-linked by the resin and therefore do not block binder function between fibers, and fibers can be bonded securely even if the fiber component is reduced.

#### 4. Brief Explanation of the Figures

The figures show an embodiment of this invention. Figure 1 is a partially exposed front elevation, Figure 2 is an expanded section cut radially, and Figure 3 is a perspective diagram of a prepreg.

- (1)     – prepreg
- (21)    – warp
- (22)    – wood
- (2)     – resin
- (4)     – minute hollow spheres

Figure 1

Figure 2

Figure 3

AMENDMENT

April 12, 1988

The Hon. Director-General of the Patent Office

1. Display of Item  
Patent Application No. 52-60060
2. Title of the Invention  
Fishing Pole
3. Party Making Amendment  
Relationship to Item: Applicant  
Shimano Industrial Co., Ltd.  
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5. Date of Amendment Order  
no date; spontaneous
6. Object of Amendment  
"Detailed Specifications" section of Specifications
7. Content of Amendment  
See attached sheet.

[Note: The 2 corrections specified have been incorporated in the translation]